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ATTORNEY'S DOCKET NUMBER

## TRANSMITTAL LETTER TO THE UNITED STATES

30681-1005

DESIGNATED/ELECTED OFFICE (DO/EO/US)

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR 1.5)

CONCERNING A FILING UNDER 35 U.S.C. 371

09/674547

INTERNATIONAL APPLICATION NO

INTERNATIONAL FILING DATE

PRIORITY DATE CLAIMED

PCT/JP98/02024

06 May 1998

TITLE OF INVENTION

PRE-DILUTED COOLANT

527 Rec'd PCT/FTO 01 NOV 2000

APPLICANT(S) FOR DO/EO/US

Masaru KAWAI; Yuji MIYAKE; and Yasuaki MORI

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
  - a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
  - b. ☒ has been transmitted by the International Bureau.
  - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☐ A copy of the International Search Report (PCT/ISA/210).
8. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
  - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
  - b. ☐ have been transmitted by the International Bureau.
  - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
  - d. ☒ have not been made and will not be made.
9. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
10. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
11. ☐ A copy of the International Preliminary Examination Report (PCT/PEA/409).
12. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).

## Items 13 to 20 below concern document(s) or information included:

13. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☐ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☐ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☒ Certificate of Mailing by Express Mail
20. ☒ Other items or information:

Unsigned Declaration and Power of Attorney  
Associate Power of Attorney

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR 1.5) <div style="font-size: 1.5em; font-weight: bold; margin-top: 5px;">09/674547</div>	INTERNATIONAL APPLICATION NO. <div style="font-weight: bold; margin-top: 5px;">PCT/JP98/02024</div>	ATTORNEY'S DOCKET NUMBER <div style="font-weight: bold; margin-top: 5px;">30681-1005</div>
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21. The following fees are submitted:

**BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :**

- ☐ Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO ..... **\$1,000.00**
- ☒ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO ..... **\$860.00**
- ☐ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO ..... **\$710.00**
- ☐ International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4) ..... **\$690.00**
- ☐ International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) ..... **\$100.00**

ENTER APPROPRIATE BASIC FEE AMOUNT =

Surcharge of \$130.00 for furnishing the oath or declaration later than months from the earliest claimed priority date (37 CFR 1.492 (e)).	<input type="checkbox"/> 20 <input type="checkbox"/> 30	\$860.00
		\$0.00

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	31	- 20 =	11	x	\$18.00
Independent claims	1	- 3 =	0	x	\$80.00
Multiple Dependent Claims (check if applicable)					<input checked="" type="checkbox"/> \$270.00
TOTAL OF ABOVE CALCULATIONS =					\$1,328.00
Reduction of 1/2 for filing by small entity, if applicable. Verified Small Entity Statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28) (check if applicable).					<input type="checkbox"/> \$0.00
SUBTOTAL =					\$1,328.00
Processing fee of \$130.00 for furnishing the English translation later than months from the earliest claimed priority date (37 CFR 1.492 (f)).					<input type="checkbox"/> 20 <input type="checkbox"/> 30    +
					\$0.00
TOTAL NATIONAL FEE =					\$1,328.00
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) (check if applicable).					<input type="checkbox"/> \$0.00
TOTAL FEES ENCLOSED =					\$1,328.00
					Amount to be: refunded \$
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**CALCULATIONS**    **PTO USE ONLY**

☒ A check in the amount of **\$1,328.00** to cover the above fees is enclosed.

☐ Please charge my Deposit Account No. \_\_\_\_\_ in the amount of \_\_\_\_\_ to cover the above fees.  
A duplicate copy of this sheet is enclosed.

☒ The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. **13-4213** A duplicate copy of this sheet is enclosed.

**NOTE:** Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

Customer No. 005179  
**PEACOCK, MYERS & ADAMS, P.C.**  
 Post Office Box 26927  
 Albuquerque, New Mexico 87125-6927  
 US

Telephone: (505) 998-1500  
 Fax (505) 243-2542

SIGNATURE

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**Jeffrey D. Myers**

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NAME

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**35,964**

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REGISTRATION NUMBER

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**November 1, 2000**

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DATE

1pt  
**PRE-DILUTED COOLANT****TECHNICAL FIELD**

This invention generally relates to a pre-diluted coolant for direct use in internal-combustion engine systems, which requires no dilution with water. More particularly, this invention relates to a pre-diluted coolant that can excellently inhibit metal corrosion and scale formation in cooling systems and improve lubrication of mechanical seals of water pumps.

**BACKGROUND ART**

Conventionally, cooling systems of internal-combustion engines utilize coolants which are prepared by diluting glycol-based or alcohol-based coolant compositions with conventional water. It is known that a conventional cooling system which comprises various metallic parts such as aluminum, aluminum alloy, cast iron, steel, brass, solder and copper parts suffers from metal corrosion, chiefly through contact with water and air contained in the coolant flowing through the cooling system. It is also known that water conventionally used to dilute coolant compositions generally contains, among other substances or hard water elements, ions such as chlorine ions, sulfuric acid ions and bicarbonate ions which are known to be metal corrosive ions. These metal corrosive ions accelerate metal corrosion, especially under high temperature and pressure environments such as in cooling systems.

In order to inhibit metal corrosions in cooling systems, it is conventional to selectively blend in coolant

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compositions metal corrosion inhibitors such as phosphates, amine salts, silicates, borates, nitrites and dibasic acids.

However, blending of such additives would raise additional problems. Phosphates tend to cause eutrophication in rivers or ponds when coolants containing phosphates are disposed of into rivers or ponds, which would increase BOD and COD in the waters. Increased BOD or COD would propagate algae, which are known to generate harmful red tides or become slimes that are to be accumulated on the riverbeds or pond beds.

Amine salts and nitrites when they coexist in coolants would chemically react with each other and produce nitrosoamine which is known to be a carcinogenic compound, while silicates are generally unstable in coolants and would easily gel when the temperature of the coolants rapidly changes or the pH value of the coolants changes and/or other salts coexist, leading to degradation in metal corrosion inhibition.

Borates are apt to corrode aluminum or aluminum alloy while nitrites will quickly degrade in coolants and lose their expected property in the coolants.

Besides chlorine ions, sulfuric acid ions and bicarbonate ions, hard water element ions such as calcium ions and magnesium ions are often melted in diluting water. Calcium and magnesium ions are known to be scale forming ions. Phosphates or dibasic acids contained in coolant compositions would chemically react with calcium and magnesium ions

contained in diluting water and would form scales or precipitation in coolants.

Scales formed as such would seriously affect corrosion inhibition function of phosphoric acids or dibasic acids, might clog circulation passages of cooling systems and/or would lower heat transfer function of coolants at high-temperature sections or spots such as cylinder head portions and valves by adhering thereto and may eventually physically damage such portions as well.

When a coolant composition containing "large" quantity of foregoing metal corrosion inhibitors is used, following problems would occur. Water or glycol in coolants where those metal corrosion inhibitors are melted would locally evaporate in the vicinities of hot spots such as mechanical seals of water pumps, and locally lower solubility of metal corrosion inhibitors in the coolants, producing precipitation of the metal corrosion inhibitors, which would adhere to the mechanical seals and eventually damage the sealing property of the mechanical seals.

The inventors of the present invention aimed at solving such water-related problems and have arrived at the present invention. Accordingly, it is a chief object of the present invention to provide a pre-diluted coolant that does not require dilution with water and thus is capable of effectively inhibiting metal corrosions and scale forming as well as improving lubrication of mechanical seals of water pumps altogether without suffering negative aspects of conventional

coolant compositions. Other objects of the present invention will become apparent from the descriptions that follow.

#### SUMMARY OF THE INVENTION

A pre-diluted coolant of the present invention which does not require later dilution with water can be directly used in the cooling system of an internal-combustion engine. The pre-diluted coolant of the present invention is characterized in that its chief component is deionized water where metal corrosive ions and scale forming ions are removed, or ethylene glycol aqueous solution prepared using such deionized water, or propylene glycol aqueous solution also prepared using such deionized water.

The term "deionized water" as used herein means water containing practically no metal corrosive ions such as chlorine ions, sulfuric acid ions and bicarbonate ions or scale forming ions such as calcium ions and magnesium ions. Such deionized water may be pure water or its practical equivalent. Such pure water may be aqueous electrolytic solution with specific resistance  $10 \times 10,000 \Omega \cdot \text{cm}$  or over prepared, e.g., by utilizing an ion-exchange resin, or may be nuclear reactor water having specific resistance  $100 \times 10,000 \Omega \cdot \text{cm}$  or over.

Since such deionized water (metal corrosive ions and scale forming ions are removed) is pre-blended in the pre-diluted coolant of the present invention, negative aspects that would otherwise be caused by the ions in the coolant can be effectively avoided. In addition, it has become possible

or feasible to substantially reduce contents of conventional metal corrosion inhibitors in coolants since progress of possible metal corrosions in cooling systems would be sufficiently slowed or inhibited by utilization of deionized water without relying much on metal corrosion inhibitors.

Local evaporation of water or glycols in the vicinities of mechanical seals would not seriously or materially affect the physical feature of the seals, because precipitation of metal corrosion inhibitors would effectively be prevented due to their limited use as will be readily appreciated by people skilled in the related art.

Further, as the pre-diluted coolant of the present invention does not practically contain scale forming ions and contains only minimum amounts of metal corrosion inhibitors, scale formation through chemical reaction between scale forming ions and certain metal corrosion inhibitors such as phosphoric acids and dibasic acids would be effectively inhibited, preventing scale precipitation and accumulation in the coolant.

The pre-diluted coolant according to the present invention selectively contains in an effective amount or amounts at least one metal corrosion inhibitor selected from alkali metal salts and amine salts of phosphoric acids, benzoic acid and alkali metal salts, ammonium salts and amine salts thereof, alkylbenzoic acids having a chemical structure  $R-C_6H_4-COOH$  (R is a C1-C5 alkyl group) and alkali metal salts, ammonium salts and amine salts thereof, alkoxybenzoic acids

having a chemical structure  $RO-C_6H_4-COOH$  (R is a C1-C5 alkyl group) and alkali metal salts, ammonium salts and amine salts thereof, cinnamic acids, alkylcinnamic acids and alkoxycinnamic acids having a chemical structure  $R-C_6H_4-CH=CHCOOH$  (R is a C1-C5 alkyl or alkoxy group) and alkali metal salts, ammonium salts and amine salts thereof, other aromatic carboxylates, C6-C12 aliphatic monobasic acids and C6-C12 aliphatic dibasic acids and their alkali metal salts, ammonium salts and amine salts, other aliphatic carboxylates, aromatic polyvalent carboxylic acids, molybdates, tungstates, vanadates, alkali metal salts of nitric acid, alkali metal salts of silicic acids, alkali metal salts of boric acids, alkali metal salts of nitrous acid, triazole hydrogencarbonate, mercaptobenzothiazole, strontium compounds, 2-phosphonobutane-1,2,4 tricarboxylic acid and alkali metal salts thereof.

#### BRIEF DESCRIPTION OF THE DRAWING

FIG.1 is a schematic view of a mechanical seal leakage unit test system.

#### EMBODIMENT/COMPARISON TESTING

A number of test samples were prepared and named Embodiments ("Emb." for short) 1-7 and Comparisons ("Com." for short) 1-7 as provided in Table I. Ethylene glycol and water were respectively mixed in the indicated weight ratios, where the indicated percentages by weight of the additives were respectively blended. Metal corrosion tests were carried out using these samples in accordance with



JIS2234-1994. II (an officially recognized Japanese test standard). Tables II-1 and II-2 show the metal corrosion test results and evaluations. The deionized (good) water used to prepare Embodiments 1-7 was ion-exchange water or distilled water with ion concentrations of chlorine 10mg/litter or lower and sulfuric acid 10mg/litter or lower, with hardness (measured in CaCO<sub>3</sub>) 20mg/litter or lower.

Bad water (1) was tap water, having ion concentrations of chlorine 49mg/litter and sulfuric acid 38mg/litter with hardness (CaCO<sub>3</sub>) 89mg/litter. Badwater (2) was ionized water containing sodium sulfate 148mg/litter, sodium chloride 165mg/litter and sodium hydrocarbon 138mg/litter. Bad water (3) was ion exchange water containing calcium chloride 275mg/litter, sodium sulfate 148mg/litter, sodium chloride 165mg/litter and sodium hydrocarbon 138mg/litter.

TABLE I

Ingredient	Emb.	Com.	Com.	Emb.	Com.	Emb.	Com.	Emb.
	1	1-1	1-2	2	2	3	3	4
Ethylene Glycol	15	15	15	50	50	30	30	15
Deionized Water	85	0	0	50	0	70	0	85
Bad Water (1)	0	85	0	0	0	0	0	0
Bad Water (2)	0	0	85	0	0	0	70	0
Bad Water	0	0	0	0	50	0	0	0

(3)								
Potassium	0.17	0.17	0.17	0.55	0.55	0.11	0.11	0.055
Hydroxide								
Ortho-	0.17	0.17	0.17	0.55	0.55	0.11	0.11	0.055
Phosphoric								
Acid								
Sodium	0	0	0	0	0	0	0	0
Hydroxide								
Sodium	0.45	0.45	0.45	1.5	1.5	0.3	0.3	0.15
Benzoate								
P-tert Butyl	0	0	0	0	0	0	0	0
Benzoic Acid								
Sodium	0.06	0.06	0.06	0.2	0.2	0.04	0.04	0.02
Molybdate								
Sodium	0.03	0.03	0.03	0.1	0.1	0.02	0.02	0.01
Mercapto-								
benzothiazole								
Tolyltriazole	0.03	0.03	0.03	0.1	0.1	0.02	0.02	0.01
Benzotriazole	0	0	0	0	0	0	0	0
Sodium	0.06	0.06	0.06	0.2	0.2	0.04	0.04	0.02
Nitrate								
pH	7.4	7.4	7.4	7.6	7.6	7.5	7.5	7.4

Ingredient	Com.	Com.	Emb.	Com.	Emb.	Com.	Emb.	Com.
	4-1	4-2	5	5	6	6	7	7
Ethylene	15	15	15	15	30	30	15	15
Glycol								
Deionized	0	0	85	0	70	0	85	0
Water								

Bad Water	85	0	0	0	0	0	0	0
(1)								
Bad Water	0	85	0	85	0	70	0	85
(2)								
Bad Water	0	0	0	0	0	0	0	0
(3)								
Potassium Hydroxide	0.055	0.055	0	0	0	0	0	0
Ortho-Phosphoric Acid	0.055	0.055	0	0	0	0	0	0
Sodium Hydroxide	0	0	0.069	0.069	0.046	0.046	0.023	0.023
Sodium Benzoate	0.15	0.15	0.15	0.15	0.1	0.1	0.05	0.05
P-tert Butyl Benzoic Acid	0	0	0.3	0.3	0.2	0.2	0.1	0.1
Sodium Molybdate	0.02	0.02	0	0	0	0	0	0
Sodium Mercapto-benzothiazole	0.01	0.01	0	0	0	0	0	0
Tolyltriazole	0.01	0.01	0	0	0	0	0	0
Benzotriazole	0	0	0.045	0.045	0.03	0.03	0.015	0.015
Sodium Nitrate	0.02	0.02	0.075	0.075	0.05	0.05	0.025	0.025
pH	7.4	7.4	7.7	7.7	7.8	7.8	7.7	7.7

TABLE II-1

Change in Weight mg/cm <sup>2</sup>					
	JIS	Emb.	Com.	Com.	Emb.
	K2234-1994	1	1-1	1-2	3
II					
Cast	±0.30	0.00	-0.15	-0.24	0.00
Aluminum					
Cast Iron	±0.15	+0.02	-0.14	-0.18	+0.05
Steel	±0.15	0.00	-0.04	-0.02	0.00
Brass	±0.15	0.00	-0.03	-0.04	0.00
Solder	±0.30	-0.10	-0.16	-0.20	-0.04
Copper	±0.15	-0.01	-0.04	-0.03	-0.01
Appearance	(5)	cast Fe cast Al/Fe			
		good	corroded	corroded	good
Foaming	(6)	good	good	good	good
(AFTER TEST)					
pH	6.5-11.0	7.1	7.2	7.2	7.1
Change in pH	±1.0	-0.3	-0.2	-0.2	-0.3
Change in Alkalinity (%)	report	-4	-5	-3	-2
Liquid Phase	(7)	good	good	good	good
Precipitation (vol.%)	≤0.5	<0.05	<0.05	<0.05	<0.05
Change in Weight mg/cm <sup>2</sup>					
	JIS	Com.	Emb.	Com.	Com.
	K2234-1994	3	4	4-1	4-2
II					
Cast	±0.30	+0.02	-0.01	-0.88	-1.24
Aluminum					

Cast Iron	$\pm 0.15$	-0.09	+0.06	-0.18	-0.17
Steel	$\pm 0.15$	-0.02	+0.03	-0.03	-0.01
Brass	$\pm 0.15$	+0.01	0.00	-0.03	-0.02
Solder	$\pm 0.30$	-0.19	-0.08	-0.18	-0.22
Copper	$\pm 0.15$	0.00	-0.01	-0.04	-0.02
Appearance	(5)	cast		cast	cast
		Fe/solder		Al/Fe	Al/Fe/solder
		corroded	good	corroded	corroded
Foaming	(6)	good	good	good	good
(AFTER TEST)					
pH	6.5-11.0	7.2	7.2	7.4	7.4
Change in pH	$\pm 1.0$	-0.2	-0.2	0	0
Change	report	-8	-5	-6	-4
in Alkalinity (%)					
Liquid Phase	(7)	good	good	good	good
Precipitation	$\leq 0.5$	<0.05	<0.05	<0.05	<0.05
(vol.%)					

TABLE II-2

Change in Weight mg/cm <sup>2</sup>					
	JIS	Emb.	Com.	Emb.	Com.
	K2234-1994	5	5	6	6
II					
Cast	$\pm 0.30$	-0.14	-0.52	-0.18	-0.48
Aluminum					
Cast Iron	$\pm 0.15$	-0.01	-0.03	-0.05	-0.18
Steel	$\pm 0.15$	0.00	-0.06	-0.05	-0.07
Brass	$\pm 0.15$	-0.03	-0.04	-0.04	-0.05

Solder	$\pm 0.30$	-0.03	-0.07	-0.10	-0.02
Copper	$\pm 0.15$	-0.05	-0.05	-0.07	-0.06
Appearance	(5)		cast		cast
			Al		Al/Fe
		good	corroded	good	corroded
Foaming	(6)	good	good	good	good

(AFTER TEST)

pH	6.5-11.0	8.4	8.5	8.3	8.6
Change in pH	$\pm 1.0$	+0.3	+0.3	+0.1	+0.4
Change	report	+4	-8	-4	-2
in Alkalinity (%)					
Liquid Phase	(7)	good	good	good	good
Precipitation	$\leq 0.5$	<0.05	<0.05	<0.05	<0.05
(vol.%)					

JIS	Emb.	Com.
K2234-1994	7	7

II

Cast	$\pm 0.30$	-0.22	-0.77
Aluminum			
Cast Iron	$\pm 0.15$	-0.10	-0.35
Steel	$\pm 0.15$	-0.07	-0.11
Brass	$\pm 0.15$	-0.08	-0.03
Solder	$\pm 0.30$	-0.14	-0.03
Copper	$\pm 0.15$	-0.11	-0.07
Appearance	(5)		cast
			Al/Fe
		good	corroded
Foaming	(6)	good	good

(AFTER TEST)

pH	6.5-11.0	8.4	8.6
Change in pH	$\pm 1.0$	+0.2	+0.4
Change	report	-5	-8
in Alkalinity (%)			
Liquid Phase	(7)	good	good
Precipitation	$\leq 0.5$	<0.05	<0.05
(vol.%)			

In Tables II-1 and II-2, the numerals (5), (6) and (7) respectively signify the following.

Numeral (5) - There is no showing of corrosion except at the contacting portions between the test sample and spacer. Change in color is not questioned.

Numeral (6) - There is no showing of foam overflow.

Numeral (7) - There is no significant change in color. There is no significant phase separation or gelation.

Embodiment 2 and Comparison 2 were further subjected to both a mechanical seal leakage unit testing and stability testing in hard water. The test conditions are provided in Table III and the test system shown in Fig.1 was utilized. The test results are given in Table IV.

TABLE III

Mechanical Seal Leakage Unit Test Conditions

Concentration v/v%	50
Time h	200

Temperature °C	90
Revolution r.p.m.	6500
External Pressure kg/cm <sup>2</sup>	1.0

The stability test was conducted using 200ml test samples in glass beakers which had been left for 24 hours at room temperatures. The test samples were centrifuged under the JIS K 2503 test conditions (an official Japanese testing standard). Amounts of precipitation were then measured.

TABLE IV

	Embodiment 2	Comparison 2
Leakage ml	<1	18
Precipitation v/v%	0	1.2



What is claimed is:

1. A pre-diluted coolant which provides effective metal corrosion inhibition and retains efficient mechanical seal function, comprising as its base component deionized water where corrosive ions and scale forming ions are practically removed or ethylene glycol aqueous solution prepared using such deionized water or propylene glycol aqueous solution prepared using such deionized water.

2. A pre-diluted coolant according to claim 1, wherein said base component contains at least one ingredient, in an effective amount or amounts, selected from the metal inhibitor group consisting of alkali metal salts and amine salts of phosphoric acids, aromatic carboxylates including benzoic acid and alkali metal salts, ammonium salts and amine salts thereof, alkylbenzoic acids having a chemical structure  $R-C_6H_4-COOH$  (R is a C1-C5 alkyl group) and alkali metal salts, ammonium salts and amine salts thereof, alkoxybenzoic acids having a chemical structure  $RO-C_6H_4-COOH$  (R is a C1-C5 alkyl group) and alkali metal salts, ammonium salts and amine salts thereof, cinnamic acids, alkylcinnamic acids and alkoxy cinnamic acids having a chemical structure  $R-C_6H_4-CH=CHCOOH$  (R is a C1-C5 alkyl or alkoxy group) and alkali metal salts, ammonium salts and amine salts thereof, aliphatic carboxylates including C6-C12 aliphatic monobasic acids and C6-C12 aliphatic dibasic acids and their alkali metal salts, ammonium salts and amine salts, aromatic polyvalent carboxylic acids, molybdates, tungstates, vanadates, alkali metal salts of nitric acid, alkali metal salts of silicic acids, alkali

metal salts of boric acids, alkali metal salts of nitrous acid, triazole hydrogencarbonate, mercaptobenzothiazole, strontium compounds, 2-phosphonobutane-1,2,4 tricarboxylic acid and alkali metal salts thereof.

3. A pre-diluted coolant according to claim 1 or 2, wherein alkali metal salts and amine salts of phosphoric acids, alkali metal salts of silicic acids, alkali metal salts of boric acids, alkali metal salts of nitrous acid, aliphatic monobasic acids and aliphatic dibasic acids are excluded and not contained in said base component, wherein at least one of 0.1-5.0 wt.% of p-tert butyl benzoic acid and alkali metal salts thereof, and at least one of 0.01-1.0 wt.% of triazoles are contained in said base component.

4. A pre-diluted coolant according to claim 1 or 2, wherein 0.01-8.0 wt.% of alkylbenzoic acids having a chemical structure  $R-C_6H_4-COOH$  (R is a C1-C5 alkyl group) or their alkali metal salts, ammonium salts or amine salts are contained in said base component.

5. A pre-diluted coolant according to claim 1 or 2, wherein 0.01-8.0 wt.% of alkoxybenzoic acids having a chemical structure  $RO-C_6H_4-COOH$  (R is a C1-C5 alkyl group) or their alkali metal salts, ammonium salts or amine salts are contained in said base component.

6. A pre-diluted coolant according to claim 1 or 2, wherein 0.01-8.0 wt.% of cinnamic acids, alkylcinnamic acids or alkoxy cinnamic acids having a chemical structure  $R-C_6H_4-$

CH=CHCOOH (R is H, or a C1-C5 alkyl or alkoxy group), or their alkali metal salts, ammonium salts or amine salts are contained in said base component.

7. A pre-diluted coolant according to claim 1 or 2, wherein alkali metal salts and amine salts of phosphoric acids, alkali metal salts of silicic acids, alkali metal salts of boric acids and alkali metal salts of nitrous acid are excluded and not contained in said base component, wherein 0.1-4.0 wt.% of at least one of sebacic acid and alkali metal salts thereof, and 0.1-3.0 wt.% of at least one of p-tert butylbenzoic acids and alkali metal salts thereof are contained in said base component.

8. A pre-diluted coolant according to claim 1 or 2, wherein phosphates, amine salts, silicates, borates and nitrites are excluded and not contained in said base component, wherein 0.1-0.4 wt.% of at least one of sebacic acid and alkali metal salts thereof, 0.1-3.0 wt.% of at least one of undecanoic diacid and dodecanoic diacid and their alkali metal salts, and 0.01-1.0 wt.% of at least one of triazoles are contained in said base component.

9. A pre-diluted coolant according to claim 1 or 2, wherein 0.02-5.0 wt.% of at least one of C6-C12 aliphatic monobasic acids and their salts, and 0.02-5.0 wt.% of at least one of alkoxybenzoic acids having a C1-C5 alkoxy group and their salts are contained in said base component.

10. A pre-diluted coolant according to claim 9, further

containing 0.1-1.0 wt.% of at least one of triazoles.

11. A pre-diluted coolant according to claim 9 or 10, wherein amine salts and borates are excluded and not contained.

12. A pre-diluted coolant according to claim 1 or 2, wherein 0.02-5.0 wt.% of at least one of hexanoic acid and heptanoic acid and their salts, and 0.02-5.0 wt.% of at least one of alkylbenzoic acids having a C1-C5 group and salts thereof are contained in said base component.

13. A pre-diluted coolant according to claim 12, further containing 0.01-1.0 wt.% of at least one of triazoles.

14. A pre-diluted coolant according to claim 12 or 13, wherein amine salts and borates are excluded and not contained.

15. A pre-diluted coolant according to claim 1 or 2, wherein 0.02-5.0 wt.% of at least one of C6-C12 aliphatic monobasic acids and salts thereof, and 0.02-5.0 wt.% of at least one of cinnamic acids, alkylcinnamic acids and alkoxycinnamic acids having a chemical structure  $R-C_6H_4-CH=CHCOOH$  (R is a C1-C5 alkyl group or alkoxy group) and their alkali metal salts, ammonium salts and amine salts are contained in said base component.

16. A pre-diluted coolant according to claim 15, further containing 0.01-1.0 wt.% of at least one of triazoles.

17. A pre-diluted coolant according to claim 15 or 16,

wherein amine salts and borates are excluded and not contained.

18. A pre-diluted coolant according to claim 1 or 2, wherein 0.01-8.0 wt.% of at least one of p-toluic acid salts and 0.002-1.0 wt.% of at least one of molybdates.

19. A pre-diluted coolant according to claim 18, further containing 0.01-8.0 wt.% of at least one of benzoates.

20. A pre-diluted coolant according to claim 18, further containing 0.01-8.0 wt.% of p-tert butylbenzoic acid.

21. A pre-diluted coolant according to any of claims 18-20, wherein nitrites are excluded and not contained.

22. A pre-diluted coolant according to claim 1 or 2, wherein 0.01-8.0 wt.% of at least one of benzoates, 0.01-8.0 wt.% of p-tert butylbenzoic acid and 0.002-1.0 wt.% of at least one of molybdates are contained in said base component.

23. A pre-diluted coolant according to claim 22, further containing 0.01-8.0 wt.% of at least one of p-toluic acid salts.

24. A pre-diluted coolant according to claim 22 or 23, wherein nitrites are excluded and not contained.

25. A pre-diluted coolant according to claim 1 or 2, wherein 0.01-8.0 wt.% of at least one of benzoates and 0.01-8.0 wt.% of at least one of p-toluic acid salts are contained in said

base component.

26. A pre-diluted coolant according to claim 25, further containing 0.01-8.0 wt.% of p-tert butylbenzoic acid.

27. A pre-diluted coolant according to claim 25 or 26, wherein nitrites are excluded and not contained.

28. A pre-diluted coolant according to claim 1 or 2, wherein 0.00002-0.1 wt.% of at least one of strontium compounds is contained in said base component.

29. A pre-diluted coolant according to claim 1 or 2, containing 0.01-3.0 wt.% of at least one of phosphoric acids and salts thereof, 0.001-0.5 wt.% of at least one of molybdenic acid, tungstic acid and vanadic acid and their salts, and 0.001-0.5 wt.% of at least one of triazoles and salts thereof.

30. A pre-diluted coolant according to claim 1 or 2, wherein 0.002-1.0 wt.% of at least one of 2-phosphonobutane-1,2,4 tricarboxylic acids and aqueous solutions thereof, at least one of phosphates, at least one of nitrates, at least one of benzoates and at least one of triazoles are contained in said base component.

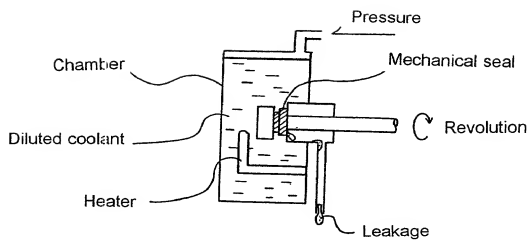
31. A pre-diluted coolant according to claim 30, wherein 0.002-2.0 wt.% of at least one of phosphates, 0.002-1.0 wt.% of at least one of nitrates, 0.02-6.0 wt.% of at least one of benzoates, and 0.01-2.0 wt.% of at least one of triazoles are contained in said base component.

# ABSTRACT

A pre-diluted coolant which does not require dilution with water for use and thus can be directly utilized in internal-combustion engine systems is disclosed. The pre-diluted coolant comprises, as its base component, deionized water where metal corrosive ions and scale forming ions are removed, ethylene glycol aqueous solution prepared using such deionized water, or propylene glycol aqueous solution prepared using such deionized water. The pre-diluted coolant provides excellent metal corrosion inhibition and scale formation inhibition.

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Fig. 1



Mechanical Seal Leakage Unit Test System



Docket No.  
30681-1005

# Declaration and Power of Attorney For Patent Application

## English Language Declaration

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

### PRE-DILUTED COOLANT

the specification of which

(check one)

☐ is attached hereto.

☒ was filed on 06 May 1998 and 01 Nov 2000 as United States Application No. or PCT International Application Number PCT/JP98/02024 and U.S. Serial No. 09/674,547, respectively and was amended on \_\_\_\_\_

(if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d) or Section 365(b) of any foreign application(s) for patent or inventor's certificate, or Section 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate or PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)

Priority Not Claimed

PCT/JP98/02024

PCT

06.05.1998

☐

(Number)

(Country)

(Day/Month/Year Filed)

☐

(Number)

(Country)

(Day/Month/Year Filed)

☐

(Number)

(Country)

(Day/Month/Year Filed)

I hereby claim the benefit under 35 U.S.C. Section 119(e) of any United States provisional application(s) listed below:

\_\_\_\_\_  
(Application Serial No.)

\_\_\_\_\_  
(Filing Date)

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\_\_\_\_\_  
(Filing Date)

\_\_\_\_\_  
(Application Serial No.)

\_\_\_\_\_  
(Filing Date)

I hereby claim the benefit under 35 U. S. C. Section 120 of any United States application(s), or Section 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. Section 112, I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, C. F. R., Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application:

\_\_\_\_\_  
(Application Serial No.)

\_\_\_\_\_  
(Filing Date)

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(Status)  
(patented, pending, abandoned)

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(Application Serial No.)

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(Filing Date)

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(patented, pending, abandoned)

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(Application Serial No.)

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(Filing Date)

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (list name and registration number)

Jeffrey D. Myers, Reg. No. 35,964

Send Correspondence to: Customer No. 005179



**005179**

PATENT TRADEMARK OFFICE

Direct Telephone Calls to: (name and telephone number)

Jeffrey D. Myers (505) 998-1500 Direct line (505) 998-1502

Full name of sole or first inventor <b>Masaru KAWAI</b>	
Sole or first inventor's signature <i>Masaru Kawai</i>	Date December 18, 2000
Residence <b>Gifu-Shi, Gifu, Japan</b>	
Citizenship <b>Japanese</b>	
Post Office Address <b>2-34-2 Daigaku-nishi</b>	
<b>Gifu-shi, Gifu, 501-1113 JAPAN</b>	

Full name of second inventor, if any <b>Yuji MIYAKE</b>	
Second inventor's signature <i>Yuji Miyake</i>	Date December 18, 2000
Residence <b>Seki-shi, Gifu, JAPAN</b>	
Citizenship <b>Japanese</b>	
Post Office Address <b>2955-6 Kurachi</b>	
<b>Seki-shi, Gifu, 501-3936 JAPAN</b>	

3-20  
Full name of third inventor, if any**Yasuaki MORI**

Third inventor's signature

*Yasuaki Mori*

Date

December 18, 2000

Residence

**Kagamigahara-shi, Gifu JAPAN** *JPX*

Citizenship

**Japanese**

Post Office Address

**2-1 Ozaki-nishimachi****Kagamigahara-shi, Gifu 504-0004 JAPAN**

Full name of fourth inventor, if any

Fourth inventor's signature

Date

Residence

Citizenship

Post Office Address

Full name of fifth inventor, if any

Fifth inventor's signature

Date

Residence

Citizenship

Post Office Address

Full name of sixth inventor, if any

Sixth inventor's signature

Date

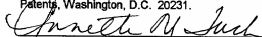
Residence

Citizenship

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PATENT APPLICATION

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 Annette M. Turk, Legal Assistant

01 November 2000  
 Date Signed

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s):	Masaru KAWAI, Yuji MIYAKE and Yasuaki MORI	:	
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For:	PRE-DILUTED COOLANT	:	

ASSOCIATE POWER OF ATTORNEY

Box: PCT  
 Commissioner for Patents  
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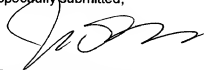
Dear Sir:

Jeffrey D. Myers, a principal attorney in the above-identified application for Letters Patent, hereby  
 appoints:

Deborah A. Peacock, Reg. No. 31,649  
 Paul Adams, Reg. No. 21,096  
 Rod D. Baker, Reg. No. 35,434  
 Brian J. Pangrle, Reg. No. 42,973  
 Andrea L. Mays, Reg. No. 43,724; and  
 Stephen A. Slusher, Reg. No. 43,924

as associate attorneys with full power.

Respectfully submitted,



Date: 01 November 2000

Jeffrey D. Myers, Reg. No. 35,964  
 Direct line: (505) 998-1502

Attorney for Applicant(s)  
PEACOCK, MYERS & ADAMS, P.C.  
P.O. Box 26927  
Albuquerque, New Mexico 87125-6927  
 Telephone: (505) 998-1500  
 Facsimile No. (505) 243-2542  
Customer No. 005179

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